Roving system for soil moisture monitoring using GNSS-R and L-band radiometry: Surveys on semi-arid grassland during SMAPEx-4

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Objectives

(i) Test the potential of a roving system for high-resolution, near real time soil moisture monitoring at regional scale;

(ii) Assess the potential of GNSS-R to estimate soil moisture and vegetation properties from a ground-based platform; and

(iii) Establish synergies between L-band signals observed with radiometry and GNSS-R techniques.

The data were collected during the fourth Soil Moisture Active Passive Experiment (SMAPEx-4) in Australia, 1-23 May, 2015.

Study area

The experiment site is located within the YB focus areas, in the South-East of the Yanco SMAP core site, NSW, Australia (see Fig. 1).

The YB5 and YB7 focus areas are each 3km x 3km in size and contain several OzNet monitoring stations (Fig. 2; www.oznet.org.au). Intensive soil moisture sampling was conducted across a 250 m grid concurrently to the roving surveys.

The land cover at the YB area is a predominantly semi-arid grassland with very little topographical features.

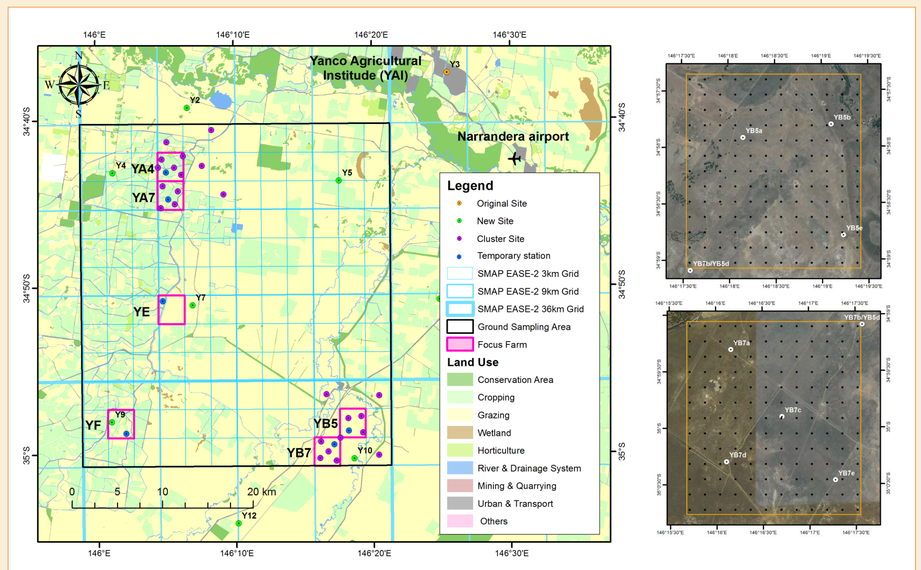


Fig. 1: (left) Overview of the Yanco SMAP core site, NSW, Australia. Focus areas for intensive soil moisture sampling are indicated with pink squares, and OzNet monitoring stations are indicated with circles. (right) Zoom of the YB5 and YB7 focus areas. Black dots indicate the 250 m grid for soil moisture sampling (from: SMAPEx-4 work plan, available online at www.smapex.monash.edu.au)

Description of the roving system

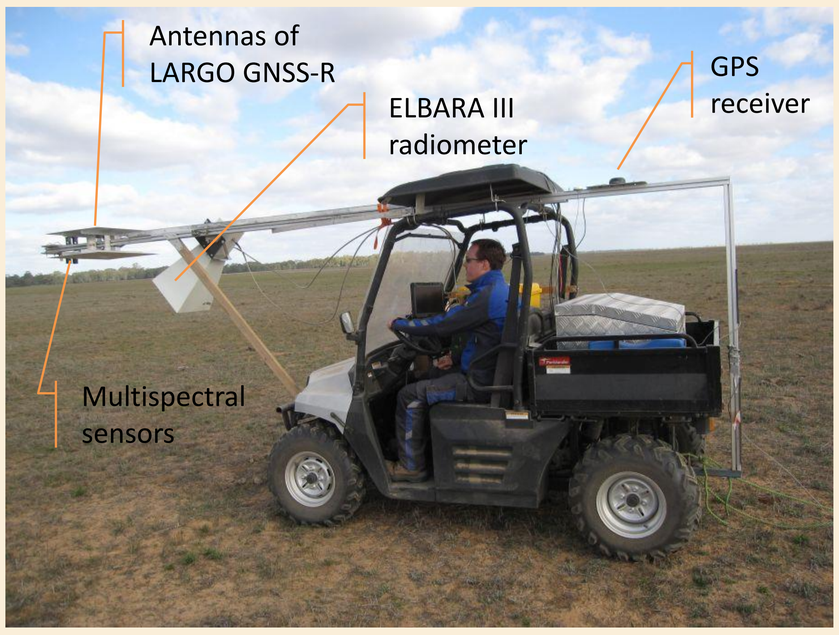


Fig. 2: Roving system used during SMAPEx-4, consisting of an L-band radiometer, a GNSS reflectometer, multi-spectral sensors and a GPS antenna.

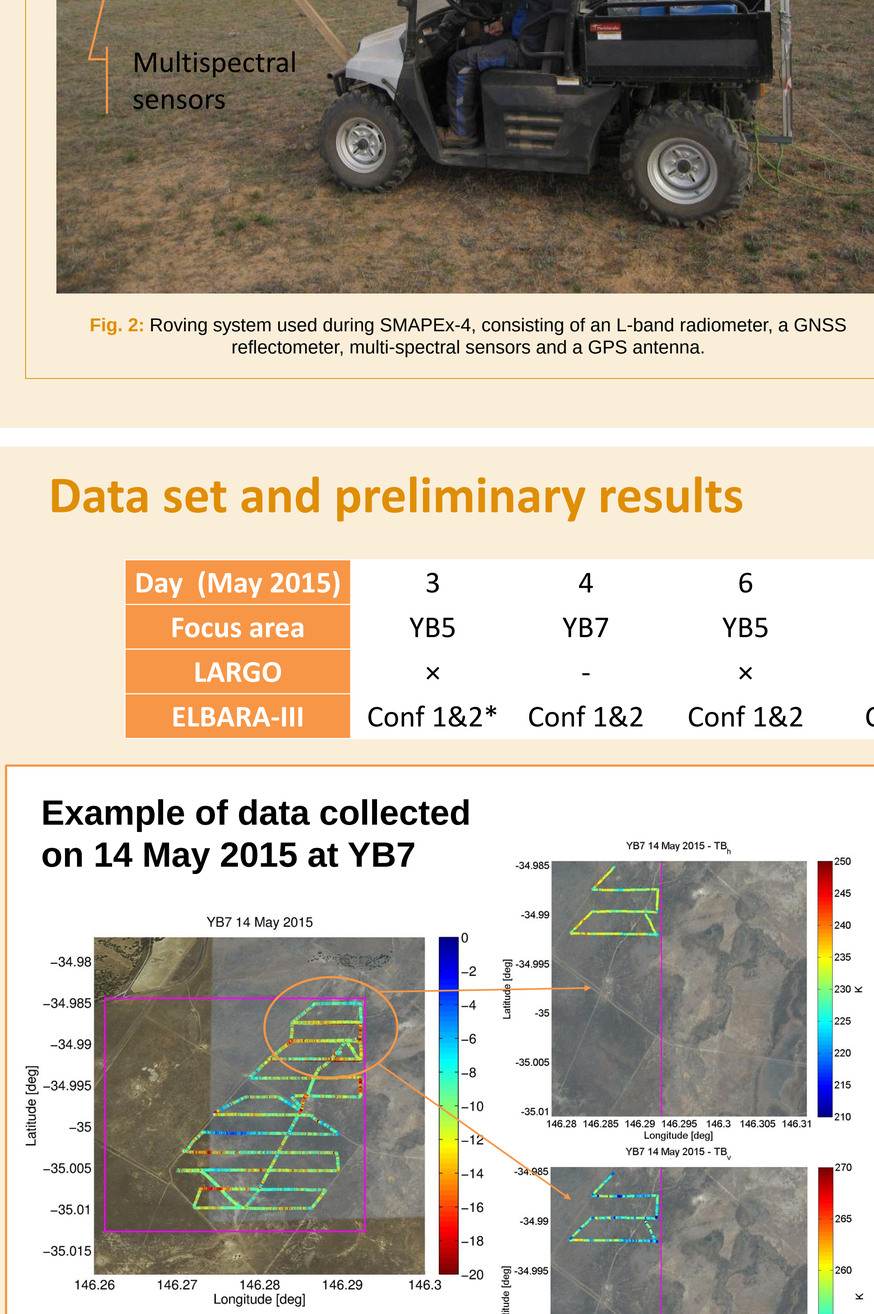
ELBARA-III	LARGO
• Based on the ETH L-band radiometer for soil moisture research (ELBARA)	• Light Airborne Reflectometer for GNSS Observations
• Horn antenna: -3dB full beamwidth of 41.1˚ in the H-plane and 31.0˚ in the E-plane	• Dual-channel: upward looking RHCP, downward looking LHCP antennas
• L-band (1.400-1.427 GHz)	• GPS L1 (1.575 GHz)
• 1.75 m above ground	• 1.95 m above ground
• Observation angle: 38˚ from the vertical	• Internal Inertial Measurement Unit (IMU)
• Internal calibration: hot resistive source (~313 K) and active cold source (~40 K)	
• External cold calibration pointing to the sky	
GPS receiver	**Multi-spectral sensors**
• Garmin GPS16X-HVS	• Skye 1850D & 1850ND, Skye 1870D & 1870ND, Apogee SI-121

Data set and preliminary results

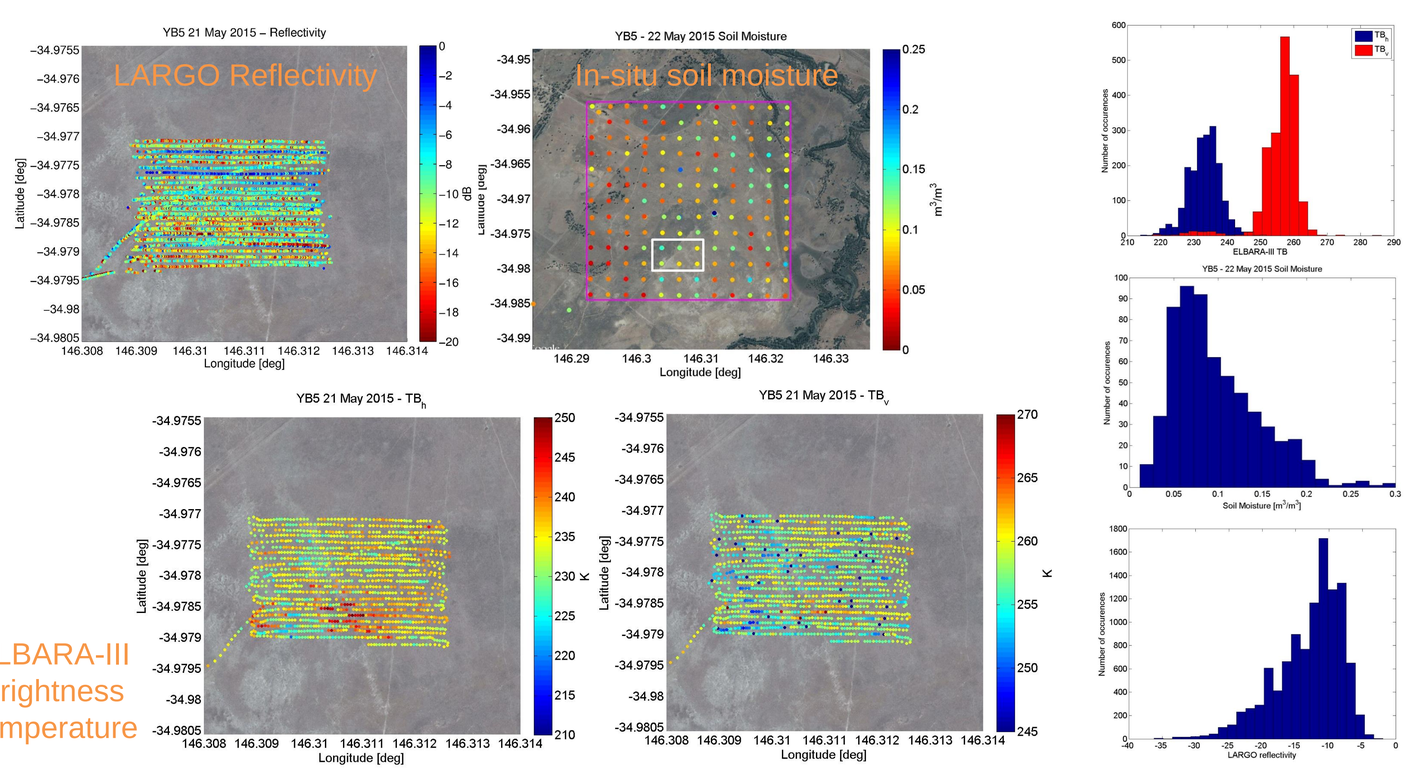
* Integration time Conf 1 > Integration time Conf 2

Day (May 2015)	3	4	6	11	12	14	16	19	20	21	22
Focus area	YB5	YB7	YB5	YB7	YB5	YB7	YB7	YB5	YB7	YB5	YB5
LARGO	×	-	×	×	×	×	-	×	×	×	×
ELBARA-III	Conf 1&2*	Conf 1&2	Conf 1&2	Conf 1&2	Conf 1&2	Conf 1&2	Conf 2	Conf 2	Conf 2	Conf 1	Conf 2

Example of data collected on 14 May 2015 at YB7



- Surveys followed part of the intensive soil moisture sampling grid



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